

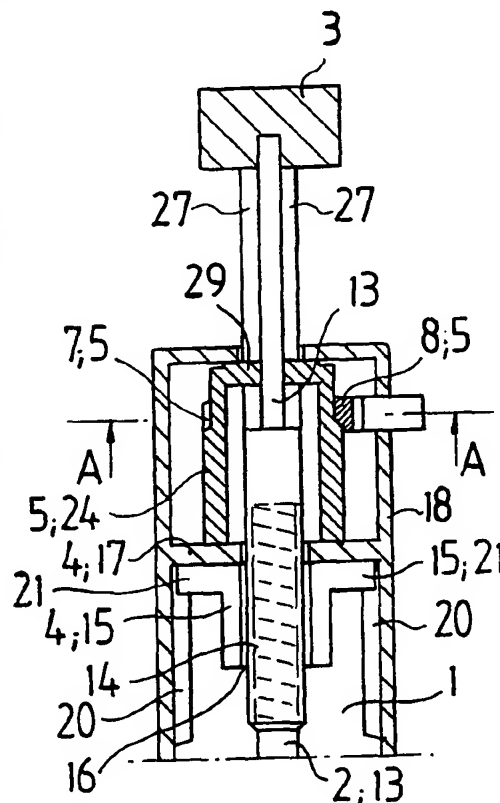


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>5</sup> :</b>  <b>B01L 3/02</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 91/16976</b>  <b>(43) International Publication Date:</b> 14 November 1991 (14.11.91)
<b>(21) International Application Number:</b> PCT/FI91/00135 <b>(22) International Filing Date:</b> 3 May 1991 (03.05.91) <b>(30) Priority data:</b> 902269 4 May 1990 (04.05.90) FI <b>(71) Applicant (for all designated States except US):</b> BIOHIT OY [FI/FI]; Verkkosaarenkatu 4, SF-00500 Helsinki (FI). <b>(72) Inventor; and</b> <b>(75) Inventor/Applicant (for US only) :</b> SUOVANIEMI, Osmo [FI/FI]; Verkkosaarenkatu 4, SF-00500 Helsinki (FI). <b>(74) Agent:</b> PAPULA REIN LAHTELA OY; Box 981, Kansakoulukatu 5 A, SF-00101 Helsinki (FI).		<b>(81) Designated States:</b> AT (European patent), BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), HU, IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent), SU, US.  <b>Published</b> <i>With international search report.</i> <i>In English translation (filed in Finnish).</i>

**(54) Title:** PROCEDURE FOR LOCKING THE ADJUSTMENT MEANS OF A PIPETTE, AND PIPETTE**(57) Abstract**

A procedure for locking a pipette, the adjustment means (4) being locked with the aid of a notched circle (7) or equivalent and of a locking member (8), the notched circle or the locking member being rotatable along with the adjustment means while the other is substantially non-rotatably connected with the body of the pipette, the locking member being locked in any desired notch of the notched circle and interlocked with the adjustment means in order to prevent inadvertent rotation, and a pipette comprising a locking means (5) which has been disposed to lock and, if so desired, to release the adjustment means (4) in its direction of rotation, the locking means (5) comprising a notched circle (7) or equivalent and a locking member (8) which has been fitted to be lockable in any desired notch (9) of the notched circle for preventing inadvertent rotation of said circle and the adjustment means (4) relative to each other, the notched circle or the locking member being rotatable along with the adjustment means while the other is substantially non-rotatably connected to the body (18).



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PROCEDURE FOR LOCKING THE ADJUSTMENT MEANS OF A  
PIPETTE, AND PIPTETTE

The present invention concerns a procedure for  
5 locking the adjustment means of a pipette, as defined  
in the preamble to Claim 1.

The invention furthermore concerns a pipette,  
as defined in the preamble to Claim 2.

A pipette is understood to be a device for  
10 liquid handling, e.g. for sampling and/or liquid dis-  
pensing, based in the first place on use of a plunger.  
The device may be a single-passage or multiple passage  
device.

In some of the pipettes, the outer body of the  
15 pipette is divided in its longitudinal direction into  
sections which can be joined by screwing. One of the  
sections constitutes a graduated adjustment ring for  
adjusting the dispensing volume of the pipette. The  
drawback embarrassing this kind of pipettes is awkward-  
20 ness and inaccuracy of adjustment, that is, the adjust-  
ment ring is easily displaced from its setting in con-  
nection with tightening. Furthermore, if the body sec-  
tions have been screwed together with excessive, or  
inadequate, force, the quantities which the device dis-  
25 penses may differ from the set dispensing volume. In  
addition, the above causes have a detrimental effect on  
the reproducibility of the liquid handling operations  
which are carried out.

Moreover, a pipette is known in the art of  
30 which the adjustment means has been constructed in con-  
junction with the body. The pipette can be adjusted by  
rotating the plunger stem, whereby the position rela-  
tive to the stem of an adjustment sleeve, or equival-  
ent, rotatable relative to the stem changes and the  
35 dispensing volume of the pipette is accordingly alter-  
ed, e.g. when the adjustm nt sleeve abuts on a limit  
stop or equivalent. The drawback of this kind of pi-

ette is the change of dispensing volume caused by even minor rotation of the plunger, i.e., when the plunger happens to rotate inadvertently e.g. when the pipette is in use, the dispensing volume is altered.

5           The object of the present invention is to eliminate the drawbacks mentioned, and to disclose a novel means for liquid handling in which adjustment of the adjustment means is easy to implement, and in which the adjustment means positively and accurately retains  
10 the position at which it has been set.

          In particular, it is an object of the invention to disclose a novel procedure for locking the adjustment means of a pipette, and a pipette with which sampling and/or liquid dispensing can be carried out  
15 accurately and reproducibly.

          Regarding the features which are characteristic of the invention, reference is made to the claims section.

          The invention is based on the idea that the  
20 locking means comprises a notched circle or the like, and a locking member disposed to be locked in any desired notch of said circle, to prevent inadvertent rotation of the adjustment means, and which can when desired be removed from the notch to enable the adjustment means to be rotated, one of the two elements, the  
25 notched circle or the locking member, being arranged to rotate along with the adjustment means and the other being connected to the body, to be substantially non-rotatable.

30           The locking means of the invention, with adjustment means, may be placed in the cylinder volume belonging to the liquid handling device, in conjunction with the plunger, with any part thereof, such as the plunger stem, with the operating means, or in general  
35 with any component of the liquid handling means.

          In an embodiment of the invention, the notched circle rotates along with the adjustment means and the

locking member is non-rotatable relative to the body. In another embodiment of the invention, the notched circle is non-rotatable relative to the body, and the locking member rotates along with the adjustment means.

5           In an embodiment of the invention, the plunger stem is provided with threads, and the adjustment means comprises an adjustment ring provided with a mating thread, the plunger stem being arranged to rotate in  
10           this ring for adjustment of the position in axial direction of the adjustment body and the plunger stem, relative to each other, and a limit stop which has been arranged to delimit the plunger motion when said adjustment ring meets said limit stop. The locking member is in that case arranged to interlock the plunger stem  
15           and the adjustment ring non-rotatably.

          Furthermore, the notched circle may be rotatable relative to the plunger stem, while the locking member is non-rotatable relative to the plunger stem. Similarly, the notched circle may be disposed to be  
20           non-rotatable relative to the plunger stem, in which case the locking member is rotatable relative to the plunger stem. In other words, either one of the notched circle and the locking member may be rotatable relative to the plunger stem, the other component being correspondingly non-rotatable relative to the plunger stem;  
25           the part which is rotatable relative to the plunger stem may then be non-rotatable relative to the body of the pipette. - The plunger stem is understood to be a stem fixedly connected with the plunger of the pipette,  
30           or a stem-like member connected thereto indirectly, e.g. with the aid of a connecting member, and moving the stem.

          The advantage of the invention over liquid handling devices of prior art is that, thanks to the  
35           locking means of the invention, the adjustment means cannot be inadvertently displaced from the position in which it has been set.

Further, thanks to the invention, the locking stations of the locking means can be furnished with graduation corresponding to the dispensing volume, and this facilitates the setting of the adjustment means for the desired volume. Hereby the adjustment can be made accurately and reproducibly.

The invention is described in the following in detail with the aid of embodiment examples, referring to the attached drawings, wherein:-

Fig. 1 presents a pipette according to the invention, with the volume adjustment means locked, Fig. 2 shows the section A-A of Fig. 1, Fig. 3 presents the pipette of Fig. 1 with the locking of the volume adjustment means released, Fig. 4 shows the section B-B of Fig. 3, and Fig. 5 presents, sectioned, another pipette according to the invention.

In Figs 1 and 3 is depicted the upper part of a pipette according to the invention, in elevational view, and sectioned. The pipette here depicted comprises a cylindrical body 18. On the lower part of the body, a pipette tip (not depicted) can be attached. The body defines within itself a cylinder volume 1, provided with a liquid passage (not depicted). In the cylinder volume a plunger 2 has been fitted to be reciprocatingly movable. To the plunger, that is to the plunger stem 13, is connected an operating means 3, in the depicted embodiment a manual operating means, for moving the plunger.

The pipette further comprises an adjustment means 4, comprising in the embodiment here depicted, a threaded plunger stem 13, an adjustment sleeve 15 provided with a mating thread, the plunger stem being disposed to be rotatable in this sleeve, and a limit stop 17. The adjustment sleeve 15 is further provided with guide members 21 fitted to cooperate with longitudinal guides 20 placed on the inside wall of the cylinder

volume 1, so that the adjustment sleeve is substantially non-rotatable along with the plunger stem.

The limit stop 17 consists of a stop face disposed to limit the motion of the plunger in the direction of the limit stop, i.e., in the filling direction as the adjustment sleeve meets the limit stop 17. Alternatively, the limit stop can be arranged to limit the plunger travel in the emptying direction. The limit stop may be of various shapes, and it may for instance be a pin, a shoulder, etc., suitably disposed within the cylinder volume so that it will meet the adjustment ring in the course of the plunger's movement.

Furthermore, the pipette of Figs 1 and 3 comprises a locking means 5 according to the invention, arranged to lock the adjustment means in the direction of rotation, i.e., to interlock the plunger stem 13 with the adjustment sleeve 15, to be substantially non-rotatable relative thereto. The locking means has been placed in the part of the cylinder volume delimited by the limit stop 17, that is on the opposite side of the cylinder volume from the plunger.

When the pipette of Figs 1 and 3 is adjusted, the locking means 5 is released and the adjustment means 4 is set with the aid of the graduation thereon provided (not visible in the figures) to the desired dispensing volume. The adjustment is made by rotating the plunger stem 13 in the adjustment sleeve 15 so that the part of the plunger stem projecting through the adjustment sleeve into the cylinder volume 1 is shortened or lengthened. The shorter the part of the plunger stem projecting through the adjustment sleeve into the cylinder volume, the greater is the dispensing volume. At the desired dispensing volume the adjustment means 4 is locked to be non-rotatable, with the aid of the locking means 5. The pipette is then ready for use.

When taking a sample or dispensing liquid, the tip of the pipettes is pushed into the liquid in case,

and the plunger 2 is pulled up with the aid of the operating means 3. The operating means may be manual, or it may be arranged to be movable in a way known in the art with a power means, such as an electric motor.

5 The plunger moves in the operating direction until the adjustment sleeve meets the limit stop 17 and stops the movement of the plunger. The liquid quantity that has been pushed into the cylinder volume is then consistent with the dispensing volume that has been set. The  
10 liquid in the cylinder volume is thereafter dispensed at the desired site by moving the plunger in the emptying direction.

The locking means depicted in Figs 1-4 comprises a locking sleeve 14 provided with a notched  
15 circle 7 and a locking member 9, fitted to be lockable in any desired notch 9. The locking sleeve 14 encircles the plunger stem 13, and on its outer circumference 7 have been arranged notches 9 (Fig. 3). The plunger stem 13 is provided with two guide grooves 27 running longi-  
20 tudinally to the stem, and the locking sleeve 24 is provided with guides 29 fitted into said grooves, so that the locking sleeve is non-rotatable relative to the plunger stem 13 but freely movable relative to the stem in its longitudinal direction.

25 The locking member 8 is non-rotatable with the adjustment means 4, i.e., it is mounted on the body 18, and it comprises a handle 31. The locking member is elastically urged against the notched circle, so that when for adjustment of the adjustment means the plunger  
30 is twisted with sufficient force, the locking member rises out of the notch, pushes into the next notch which comes into register, rises out of this latter notch, and so on, until the desired dispensing volume setting has been reached. The turning is stopped when  
35 the locking member enters the notch corresponding to the desired dispensing volume, the locking member becoming locked in this notch, i.e., it does not rise out



of the notch without plunger-turning force surpassing a given threshold.

The graduation of the adjustment means 4 is advantageously arranged to conform to the locking stations, i.e., to the notches so that a given locking station, or notch, coincides with corresponding dispensing volume on the graduation. The graduation is advantageously marked in accordance with the dispensing volume increment corresponding to the smallest possible rotation step, this increment suitably corresponding to the distance between two adjacent notches.

In the operating situation, the locking member 8 is locked in a notch 9 for locking the adjustment means 4 (Figs 1-3). When the adjustment means is adjusted, the locking member is first removed from the notch by displacing it, with the handle 31, to a position above the notched circle 7 (Fig. 3). The adjustment means can now be turned freely. The locking member 8 has been moved to a position outside the notched circle 7, whereby rotation of the locking sleeve, and thus of the plunger stem, is enabled.

In the embodiment depicted in Figs 1-4, the locking sleeve 24 with its notched circle 7 is separate from the plunger stem 13. If desired, the notched circle 7 may be integrally affixed to the plunger stem. Further, in an embodiment of the invention, the circle provided with locking stations may be connected with the adjustment means by mediation of other elements, e.g. of gear transmissions. It is obvious that the circle provided with locking stations, e.g. a notched circle, may equally be arranged to be non-rotatable with the adjustment means, for instance non-rotatably encircling the plunger stem, and the locking member may be arranged to rotate along with the plunger stem.

The reference numerals in the presentation of a pipette in Fig. 5 are mainly consistent with those in Figs 1-3. In Fig. 5, the locking member 8 is provided,

with a spring 32 which urges the locking member against the locking notches of the notched circle 7, i.e., of the sleeve-like member. The pipette comprises no specific means for undoing the locking; thanks to the spring the stem 13 can be rotated by the handle 3, and when the turning force surpasses a given threshold the stem is enabled to turn as the locking member rises out of the locking notch, to fall again into the next locking member when the rotation continues. The locking is hereby elastic, preventing inadvertent adjusting of the pipette.

In the embodiment depicted in Fig. 5, the knob of the operating means 3 is provided with a freely turning cap 33, whereby the pipette cannot be inadvertently adjusted when pressure and rotation is applied upon the cap 33.

The embodiment examples are only meant to illustrate the invention, without restricting it in any way whatsoever.

## CLAIMS

1. A procedure for locking the adjustment means (4) of a pipette, said adjustment means being  
5 rotatable and disposed to limit the travel of the pipette's plunger (2) in a cylinder volume (1), characterized in that the adjustment means (4) is locked with the aid of a notched circle (7) or equivalent and of a  
10 locking member (8), one of the two, notched circle and locking member, being rotatable along with the adjustment means while the other is substantially non-rotatably connected with the body of the pipette, the locking member being locked in any desired notch of the notched circle and interlocked with the adjustment  
15 means in order to prevent inadvertent rotation.

2. A pipette, comprising a body (10); a cylinder volume (1), which has been formed within the body and provided with a liquid passage; a plunger (2), fitted into the cylinder to be reciprocatingly movable;  
20 an operating means (3), arranged to move the plunger for conducting liquid into the cylinder volume, respectively for dispensing liquid out from the cylinder and through the liquid passage; an adjustment means (4) which is rotatable and has been disposed to limit the  
25 movement of the plunger in its direction of motion by rotating the adjustment means for adjusting the dispensing volume; and a locking means (5) which has been disposed to lock and, if so desired, to release the adjustment means (4) in its direction of rotation, characterized in that the locking means (5) comprises a  
30 notched circle (7) or equivalent and a locking member (8) which has been fitted to be locked in any desired notch (9) of the notched circle for preventing inadvertent rotation of said circle and the adjustment means  
35 (4) relative to each other, one of the two, notched circle or locking member, being rotatable along with the adjustment means while the other is substantially

non-rotatably connected to the body (10).

3. Pipette according to claim 2, characterized in that the notched circle (7) is rotatable along with the adjustment means (4) and the locking member (8) is non-rotatable relative to the body (18).

4. Pipette according to claim 2, characterized in that the notched circle (7) is non-rotatable relative to the body (18) and the locking member (8) is rotatable along with the adjustment means (4).

5. Pipette according to any one of claims 2-4, characterized in that the plunger stem (13) is provided with a thread (14) in its longitudinal direction, that the adjustment means (4) comprises an adjustment sleeve (15) which is provided with a mating thread (16), the plunger stem and adjustment ring being rotatable relative to each other for adjusting their position relative to each other; that the means comprises a limit stop (17) which has been disposed to limit the movement of the plunger as the adjustment sleeve meets the limit stop; and that the locking means (5) is arranged to lock the plunger stem to be non-rotatable relative to the body (18).

6. Pipette according to claim 5, characterized in that the notched circle (7) is rotatable relative to the plunger stem (19) and the locking member (8) is non-rotatable relative to the plunger stem.

7. Pipette according to claim 5, characterized in that the notched circle (7) is non-rotatable relative to the plunger stem and the locking member (8) is rotatable relative to the plunger stem.

8. Pipette according to any one of claims 2-8, characterized in that the pipette comprises a manual operating means with knob (3) which is provided with a freely turnable cap (33).

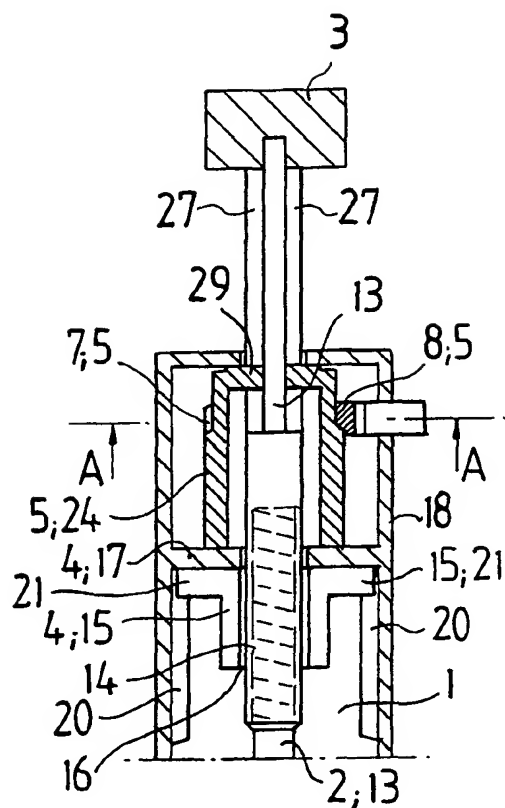


Fig. 1

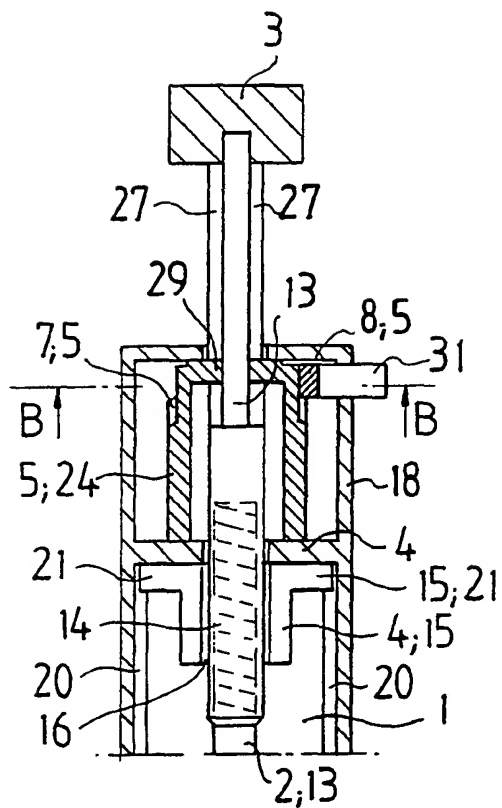


Fig. 3

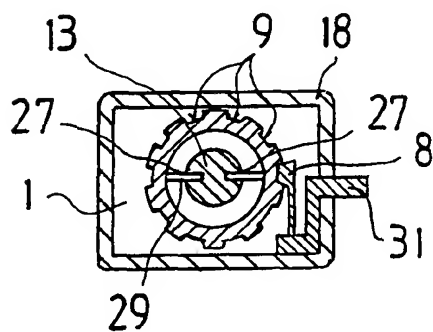


Fig. 2

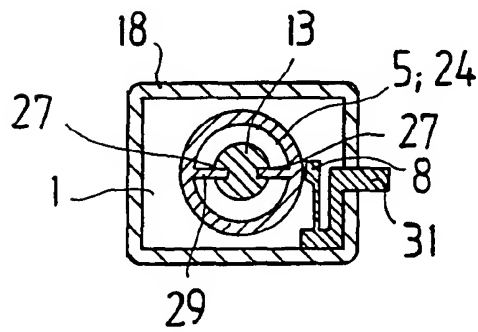


Fig. 4

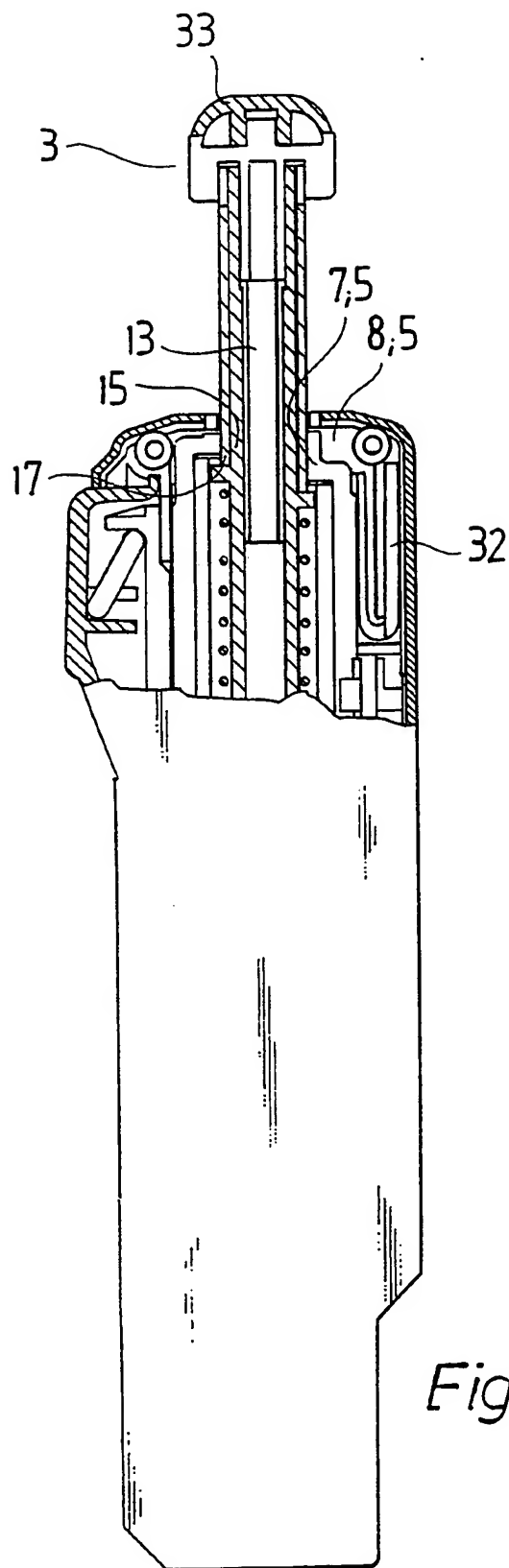


Fig.5

# INTERNATIONAL SEARCH REPORT

International Application No PCT/FI 91/00135

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (if several classification symbols apply, indicate all) <sup>6</sup>		
According to International Patent Classification (IPC) or to both National Classification and IPC		
IPC5: B 01 L 3/02		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched <sup>7</sup>		
Classification System	Classification Symbols	
IPC5	B 01 L; G 01 N; G 01 F	
Documentation Searched other than Minimum Documentation to the extent that such Documents are included in Fields Searched <sup>8</sup>		
SE,DK,FI,NO classes as above		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT<sup>9</sup></b>		
Category *	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>
X	FI, B, 57543 (KOMMANDIITTIYHTIÖ FINNPIPETTE OSMO A.) 30 May 1980, see claim 1 --	1,2,3,8
X	EP, A2, 0153058 (LABSYSTEMS OY) 28 August 1985, see page 2, line 32 - page 3, line 35; page 4, line 12 - line 22; figure 1 --	1-4,8
A	WO, A1, 8400119 (LABSYSTEMS OY) 19 January 1984, see page 1, line 24 - line 32 -- -----	1-8
<p>* Special categories of cited documents: <sup>10</sup></p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&amp;" document member of the same patent family</p>		
<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
9th August 1991	1991-08-1	
International Searching Authority	Signature of Authorized Officer	
SWEDISH PATENT OFFICE	Gunnel Wästerlid <i>[Signature]</i>	

**ANNEX TO THE INTERNATIONAL SEARCH REPORT  
ON INTERNATIONAL PATENT APPLICATION NO.PCT/FI 91/00135**

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the Swedish Patent Office EDP file on **91-06-27**.  
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FI-B- 57543	80-05-30	NONE	
EP-A2- 0153058	85-08-28	JP-A- 60241937	85-11-30
WO-A1- 8400119	84-01-19	EP-A-B- 0112887	84-07-11
		US-A- 4554134	85-11-19